ONTARIO WATER RESPONSE - 2000

DRAFT

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Ontario Ministry of Agriculture, Food and Rural Affairs
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PREFACE

During the spring and summer of 1999, southwestern and eastern Ontario experienced an extended period of low rainfall and high temperatures. These weather conditions resulted in some of the lowest water levels and driest soils recorded for several decades.

While Ontario has experienced drought-like conditions before (1988 being the most recent example), the potential impacts of global warming, coupled with escalating demands for water, suggest these occurrences may be more common and perhaps more broadly felt in the future.

The provincial government has, therefore, decided to prepare, for the first time in its history, a response plan to deal with low water conditions.

EXECUTIVE SUMMARY

Ontario Water Response – 2000 is intended to ensure provincial preparedness, to assist in coordination and to support local response in the event of a drought this year. This plan is based on existing legislation and regulations and builds on existing relationships between the province and local government bodies.

Ontario has been experiencing lower than average precipitation and low water levels for over a year, and in some cases longer. Some Great Lake water levels (Erie, Huron) are lower than they have been for many years, and tributary flow has decreased. Groundwater levels may also be decreasing. Historically, periods of dry weather and low water levels or drought are relatively uncommon in Ontario (about every 10-15 years). However, recent studies on changing weather patterns indicate that low water levels may become more common, perhaps compounded by the province's steadily increasing demands for water.

The Provincial Low Water Level Response Task Force was formed in May, 1999, to coordinate an inter-ministry response to low water levels and make recommendations for long term management of low water conditions. The task force report, September 1999, recommended that the government develop a provincial low water level strategy by March 2000. The ministries involved set up a project team to develop the drought response strategy.

Ontario Water Response – 2000 has been produced to ensure that the province is prepared for this summer, in case the low water conditions of 1999 in southwestern and eastern Ontario continue.

This plan recognizes the partnership between provincial and local authorities and that natural resource and environmental management must be approached at both the provincial and local levels. The provincial level normally provides overall direction and coordinates policies, science and information systems and emergency support. At the local level, the emphasis is normally directed to collecting information, interpreting policy, delivering programs and responding to emergencies.

The report provides definitions of drought and low water and describes the means of measuring and quantifying drought and the conditions leading up to it. Three condition levels are described: Level I (warning), Level II (conservation) and Level III (restrictions). Precipitation and streamflow indicators, used to determine the level for watersheds, are identified. Thresholds for these indicators are provided with the methodology for determining when an area of the province passes from one level to another.

The roles and responsibilities of the province and its agencies are described. This plan recommends the formation of an Ontario Water Directors' Committee, which would go into action when any watershed enters a Level II condition. This plan also provides detail on the response process at the local level. This includes the proposed network of local Water Response Teams, their membership, roles and responsibilities. Also outlined are steps a local Water Response Team could take.

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ONTARIO WATER RESPONSE - 2000

1. CONTEXT

Fresh water is a natural resource crucial to the economic and environmental well being of Ontario. Water supports human activity in almost all aspects, from health to industrial development to recreation. Because water is critical to so much of our activity, it is managed from several perspectives and by many jurisdictions, groups and individuals.

1.1 The Spectrum of Water Management

Ontario Water Response – 2000 is a strategy to deal with only one end of the spectrum of water management issues, which range from flood through normal to low-water conditions. The best strategies for avoiding drought are long-term approaches that manage both water supply and demand. These include public education, conservation, the development of appropriate land use policies and efficient water management infrastructures such as reservoirs and aquifer recharge facilities.

1.2 Provincial and Local Management

Ontario is large and geographically diverse. One area can have high water flows while another is dealing with lower than normal conditions. In the summer of 1999, for example, southwestern Ontario had near-record low water flows while above average rainfall in some parts of northwestern Ontario meant the river and lake levels there were recovering.

Natural resource and environmental management must be approached at two scales - provincial and local. The province normally provides overall direction, program policies, science and information systems, and emergency support. At the local level, the emphasis is normally directed to interpreting policy, delivering programs, collecting information and responding to emergencies.

This water response plan reflects this historical partnership. Much of Ontario, with its municipal structures and conservation authorities, has the framework for dealing with low water conditions.

1.3 Existing Legislation and Information

Ontario Water Response – 2000 is based on existing legislation and regulations. The recommended structures and processes can be implemented under established legal authorities (see Appendix 1) such as the *Municipal Act*, the *Lakes and Rivers Improvement Act* and the *Ontario Water Resources Act*. As is the case with developing and implementing any plan, especially one for unusual or emergency situations, this plan will improve over time and through experience.

This plan has been developed using existing science, data collection networks and analysis processes.

2. MONITORING AND REPORTING ON DROUGHT

This section provides a definition of drought and the means of measuring and quantifying drought and the conditions leading to it. For additional technical information, see Appendix 2.

2.1 Definition – Drought/Low Water

Drought is a complex term that has various definitions, depending on individual perceptions. In this document, drought is defined as weather and low water conditions characterized by one or more of the following:

a) below normal precipitation for an extended period of time (2 months or more), potentially combined with high rates of evaporation that result in lower lake levels, streamflows or baseflow or reduced soil moisture or groundwater storage

b) streamflows at the minimum required to sustain aquatic life while only meeting high priority demands for water, water wells becoming dry, surface water in storage allocated to maintain minimum streamflows

c) socio-economic effects occuring on individual properties and extending to larger areas of a watershed or beyond.

As larger areas are affected and as low water and precipitation conditions worsen, the effects usually become more severe.

Three Levels of Low Water Conditions

The Level I condition is the first indication of a potential water supply problem. Level II indicates a potentially serious problem. Level III indicates the failure of the water supply to meet the demand, resulting in progressively more severe and widespread socio-economic effects.

Each level requires a water management response from the local authority or the province, or both. The authority learning of the change in level will alert the other to the condition.

2.2 Indicators

Measuring drought is complex, requiring the collection of data for variables such as rainfall, streamflow, soil moisture, and water in storage. Indicators have been chosen that integrate a number of factors and functions, are based on readily available data, are useful over a range of time periods and allow water managers to speak consistently about water.

Starting in April, 2000, precipitation and streamflow (surface water flow) measurements are the two primary indicators for managing low water levels and drought.

Other indicators to measure baseflow, groundwater and aquifer levels are to be developed.

Precipitation Indicators

Precipitation is the most important and convenient indicator. Reviewing the precipitation data and comparing it to trends will warn of an impending water shortage.

Precipitation Indicator 1

The Ministry of Natural Resources (MNR) will compare monthly data from each precipitation station with the average expected monthly precipitation for that station. These calculations will be made for the previous 18 months (long-term), for the previous 3 months (seasonal) and, under a Level I condition or higher, for the previous month (short-term), with weekly updates.

Precipitation Indicator 2

If a watershed is under a Level I or Level II condition, MNR will add up the number of consecutive readings that register no rain (less than 7.6mm).

Streamflow Indicator

Gauges in streams measure streamflow. These indicators show if there is enough streamflow in the river to meet the basic needs of the ecosystem and if water is available for other uses such as recreation, hydropower generation or irrigation.

MNR will compare the monthly flow for each streamgauge station with the lowest expected average summer month flow for the station.

TABLE 1: Summary of Indicators

Precipitation	Surface Flow
1. **% of average =** monthly precipitation/ average precipitation expected for that month 2) **Weeks with less than 7.6mm of rain** (number of consecutive readings)	**% of average** = monthly flow/ lowest average summer flow

Moving from one level to another

When the indicator for precipitation or streamflow crosses a threshold, a watershed, or a portion of it, has changed to a Level I, Level II, or Level III condition. When a watershed condition changes, a water management response is undertaken. When a threshold is crossed, the determining authority (local or provincial) will alert the other authority to the change. The values of thresholds have been set for precipitation and streamflow at selected stations. Indicators will be monitored and reviewed periodically to determine if the thresholds are set at the correct levels.

Precipitation thresholds

A watershed enters Level I when its 3-month or 18-month total precipitation drops below 80% of the average 3-month or 18-month precipitation for those months.

A watershed enters Level II when its 3-month or 18-month total precipitation drops below 60% of the average 3-month or 18-month precipitation for those months or when its 1-month total precipitation drops below 60% of the average precipitation for that month and it is already in Level I. Alternatively, the watershed would enter Level II if it is already in Level I and has had no rain (less than 7.6mm) for 2 readings in succession (high demand areas) or for 3 readings in succession (moderate demand areas).

A watershed enters Level III when its 3-month or 18-month total precipitation drops below 40% of the average 3-month or 18-month precipitation for those

months or when when its 1-month total precipitation drops below 40% of the average precipitation for that month and it is already in Level I or Level II.

TABLE 2: Precipitation Thresholds

Level I	Level II	Level III
18-month precipitation < 80% of average expected precipitation or 3 month precipitation < 80% of average precipitation	18 month precipitation < 60% of average precipitation or 3 month precipitation < 60% of average precipitation or *1 month precipitation < 60% of average precipitation *Weeks with less than 7.6mm of rain – more than 1 week for high demand areas; more than 2 weeks for moderate demand areas	18 month precipitation < 40% of average precipitation or 3 month precipitation < 40% of average precipitation or **1 month precipitation < 40% of average precipitation

* Existing Level I (can't get to Level II this way without first being in Level I)
** Existing Level II (can't get to Level III this way without first being in Level II)

Streamflow

In the spring, a watershed enters Level I when its monthly flow drops below the lowest average summer month flow for that station. For the rest of the year, the watershed enters Level I when its monthly flow drops below 70% of the lowest average summer month flow.

In the spring, a watershed enters Level II when its monthly flow drops below 70% of the lowest average summer month flow. In summer, fall and winter, the watershed enters Level II if its monthly flow drops below 50% of the lowest average summer month flow.

In the spring, a watershed enters Level III when its monthly flow drops below 50% of the lowest average summer month flow. In the other seasons, the watershed enters Level III if its monthly flow drops below 30% of the lowest average summer month flow.

TABLE 3: Streamflow Thresholds

Level I	Level II	Level III
Spring: – monthly flow < lowest average summer month flow **Other times:** – monthly flow < 70% of lowest average summer month flow	**Spring:**– monthly flow < 70% of lowest average summer month flow **Other times:** – monthly flow < 50% of lowest average summer month flow	**Spring:**– monthly flow < 50% of lowest average summer month flow **Other times:** – monthly flow < 30% of lowest average summer month flow

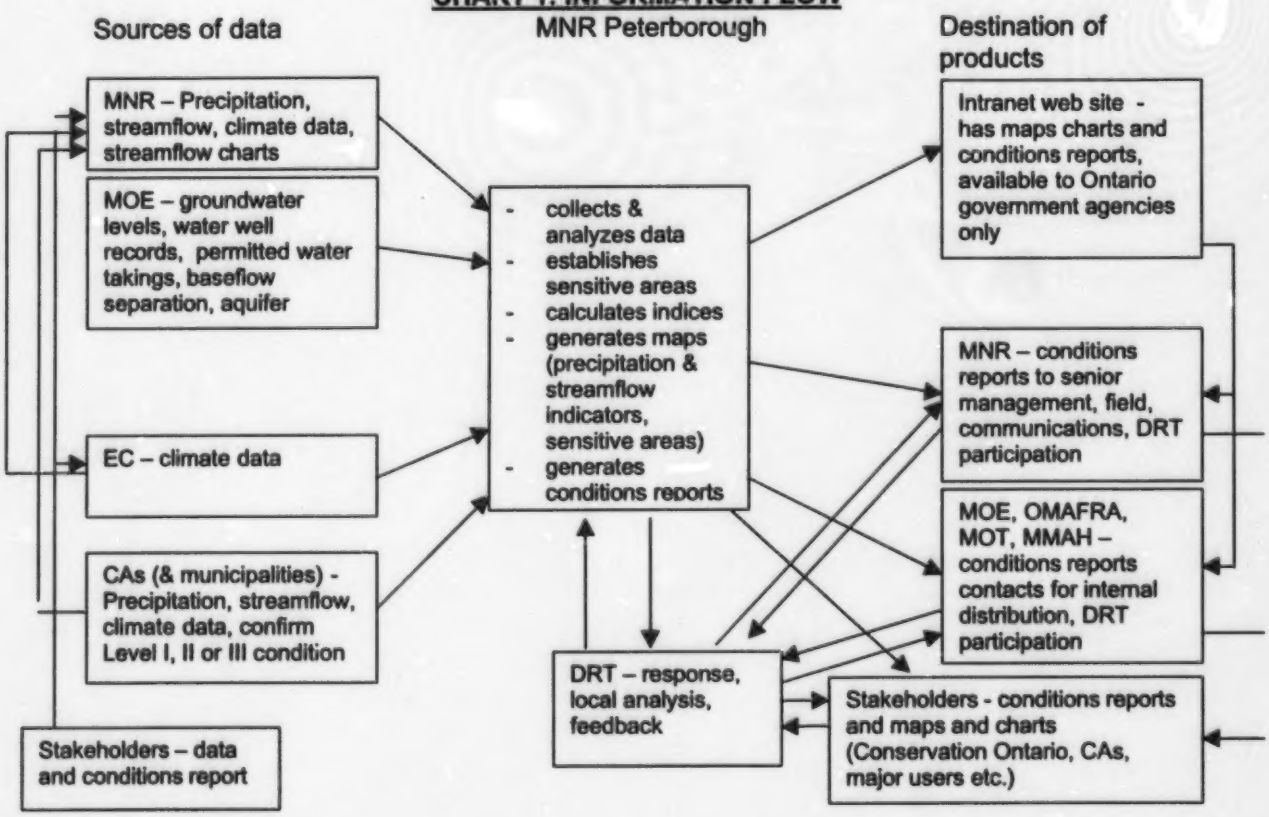
TABLE 4: LEVELS & INDICATORS FOR APRIL 2000

Condition	Indicator	
	Precipitation	Streamflows
Level I	80% of average	**Spring:** – monthly flow < lowest average summer month flow **Other times:** – monthly flow < 70% of lowest average summer month flow
Level II	60% of average weeks with < 7.6mm	**Spring:**– monthly flow < 70% of lowest average summer month flow **Other times:** – monthly flow < 50% of lowest average summer month flow
Level III	40% of average	**Spring:**– monthly flow < 50% of lowest average summer month flow **Other times:** – monthly flow < 30% of lowest average summer month flow

2.3 Monitoring and Reporting

Chart 1 shows the participants, data sources, products and information flow for drought monitoring. Data is provided to MNR, which analyzes it and produces and distributes conditions reports and maps. Feedback is provided to MNR on local conditions as well as when environmental management responses are made.

CHART 1: INFORMATION FLOW


Sources of data
MNR Peterborough
Destination of products
MNR – Precipitation, streamflow, climate data, streamflow charts
MOE – groundwater levels, water well records, permitted water takings, baseflow separation, aquifer
EC – climate data
CAs (& municipalities) - Precipitation, streamflow, climate data, confirm Level I, II or III condition
Stakeholders – data and conditions report
- collects & analyzes data
- establishes sensitive areas
- calculates indices
- generates maps (precipitation & streamflow indicators, sensitive areas)
- generates conditions reports
DRT – response, local analysis, feedback
Intranet web site - has maps charts and conditions reports, available to Ontario government agencies only
MNR – conditions reports to senior management, field, communications, DRT participation
MOE, OMAFRA, MOT, MMAH – conditions reports contacts for internal distribution, DRT participation
Stakeholders - conditions reports and maps and charts (Conservation Ontario, CAs, major users etc.)

CAs - conservation authorities
CO – Conservation Ontario
WRT – Water Response Team
EC – Environment Canada

3. PROVINCIAL RESPONSE

3.1 Principles

Ontario Water Response – 2000 is based on three principles: the response process should be simple and straightforward, low water and drought response is a partnership, and planning is crucial.

a) Simple process

Experience from across the province suggests that good emergency response happens when there is a straightforward system that sets out clearly who is involved and what their responsibilities are. This plan details this system for low water conditions. Section 2 sets out how low water information is to be collected and used, Sections 3.3 and 3.4 detail provincial level roles and responsibilities, and Section 4 covers local response. Section 5 provides an action plan.

b) Low water and drought response partnership

The management of water must occur on at least two levels – provincial and local. For example, this plan indicates that the province is responsible for collecting and analyzing information on water levels across the province, while the local conservation authorities play a major role in providing the information and, more importantly, in interpreting it in terms of their local knowledge.

c) Plan

Low water conditions do not occur in a few hours or even days, but build up over a number of weeks or months. This time factor allows advance preparation, both at the provincial and municipal levels.

3.2 Agency Roles and Responsibilities

The key provincial agencies in water management are the Ministries of Municipal Affairs and Housing; Economic Development and Trade; Agriculture, Food and Rural Affairs; Environment; and Natural Resources. They work in a cooperative, integrated fashion to develop and implement provincial water policy.

These efforts are directed by the Land and Resources Committee of deputy ministers and implemented by the Committee of Ontario Water Directors. This committee is co-chaired by the directors from the Ministries of Natural Resources and Environment. *Ontario Water Response – 2000* has been prepared by a project team reporting to this committee.

Ministry of Municipal Affairs and Housing (MMAH) is responsible for overseeing such legislation as the *Planning Act*, the *Municipal Act* and the *Public Utilities Act*. The *Planning Act* provides for and supports land development in the organized sections of the province. The appropriate use of this legislation helps ensure that areas critical to the long-term ecological health of water systems are not degraded by changes in land use. The *Municipal* and *Public Utilities Acts* allow municipalities to construct and maintain water supply infrastructures and pass bylaws to regulate water use.

Ministry of Economic Development and Trade (MEDT) plays a leading role in promoting and explaining the government's position and policies on water management issues that cross provincial or national boundaries. Recently, MEDT has represented the province in discussions over bulk water transfers and diversions from the Great Lakes.

Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has an important role in the protection of water ecosystems across the rural landscape of Ontario. The ministry supports programs for the agricultural sector that assist in maintaining potable water supplies, supports the use of appropriate irrigation and drainage methods and helps protect surface and ground water quality.

Because of the extent of agriculture in southern and central Ontario and its potential to affect the health of lakes and rivers, the cooperation of the agricultural sector is critical to the long-term sustainability of water systems and to the application of short-term water management strategies.

Ministry of the Environment (MOE) administers legislation that applies directly to water quality and quantity. Under the *Ontario Water Resources Act*, MOE can regulate large-scale water withdrawal activity and has developed comprehensive permit systems for taking water and constructing wells. This Act also allows for the allocation of water among users. Through legislation such as the *Environment Protection Act* and the *Pesticides Act*, this ministry has a major role in protecting the quality of water and has extensive standards for waste water treatment.

Ministry of Natural Resources (MNR) has two primary focuses in water management: managing surface water flows and levels and protecting fish and wildlife habitat. In many areas MNR is directly responsible for operating water control structures. The major pieces of legislation this ministry oversees include the *Lakes and Rivers Improvement Act* (regulates location, design and operation of dams and other water structures), the *Public Lands Act* (allocation of water power sites), some aspects of the federal *Fisheries Act*, the *Conservation Authorities Act* (supporting legislation for the province's 38 watershed-based

conservation authorities), the *Fish and Wildlife Conservation Act* and the *Crown Forest Sustainability Act*. Under the *Emergency Plans Act*, MNR is listed as the lead agency for large-scale flooding emergencies.

Although MMAH, MEDT, OMAFRA, MOE and MNR are the five provincial agencies with a clear leadership role in water management, other agencies and organizations are also involved in water issues. The Ministry of Northern Development and Mines has a responsibility for setting policy regulating mine waste control structures, and the Ministry of Transportation is involved with water crossing standards. In addition, the federal government has legislation, such as the *Fisheries Act* and the *Beds of Navigable Waters Act*, that must be considered in any approach to water management.

Municipalities and conservation authorities also have discrete water management responsibilities and must be included in any low water and drought response.

3.3 Response Framework

One of the ways Ontario prepares for and manages emergency situations is through the *Emergency Plans Act*. This Act, regulated by the Office of the Solicitor General, identifies lead agencies, which vary depending on the nature of the emergency, and provides for the development of response strategies by both ministries and municipalities. This Act also authorizes mayors and reeves to declare local emergencies and ministers to declare emergencies on a broader scale.

Drought, although it is not a sudden and unpredicted event, will be identified in the policies and procedures under the *Emergency Plans Act*. The Ministry of Natural Resources will be listed as the lead agency. This plan sets out a model similar to those outlined in the Act.

This plan proposes that:

a) In the organized areas of the province where conservation authorities exist:
   - the local conservation authority establish a water response team (WRT). Efforts should be made to have these teams in place for watersheds that reach Level I or above. Other areas may want to establish these teams as a precautionary measure.
   - the municipalities review their Emergency Response Plans and incorporate low water response strategies.

b) In organized areas with no conservation authorities:

- the district office of the Ministry of Natural Resources take the lead to establish a WRT if Level I or above conditions are reported
- the municipalities review their Emergency Response Plans and consider incorporating low water response strategies.

c) In unorganized areas the Ministry of Natural Resources maintain responsibility for water management issues, dealing directly with local communities, First Nations and dam owners and operators.

d) An Ontario Water Directors' Committee (OWDC) be set up if any watershed confirms Level II conditions. The principal members of the committee will be the appropriate field and water directors of the Ministries of Environment, Agriculture and Food, and Natural Resources. The Ontario Water Directors' Committee will be responsible for coordinating the provincial response efforts.

Level I - Voluntary Conservation

The chair of the watershed's water response team will determine that the watershed has entered a Level I condition. This condition will be managed through existing programs of the key provincial agencies and municipalities with leadership and direction provided by the WRT. The WRT, using a variety of communications tools, will emphasize the need for voluntary water conservation with a target reduction of water use of 10 per cent. District or regional level ministry staff will be part of the WRT.

Level II - Conservation and Restrictions on Non-Essential Use

The chair of the watershed's water response team will determine that a watershed has entered a Level II condition. In this condition the WRT will continue in a leadership role, communicating a strong conservation message and implementing restrictions through the municipalities on non-essential use. The Ontario Water Directors' Committee will be activated and cross-ministry program co-ordination emphasized. The OWDC will inform Emergency Measures Ontario.

Level III - Conservation, Restriction, Regulation

The chair of the watershed's water response team, after consulting the OWDC chair, will determine that a watershed has entered a Level III condition. In this condition, the appropriate mayor or reeves or their representatives will join the WRT. The Ontario Water Directors' Committee will work with and support the

WRT by helping in the decisions on water allocation priorities and in implementing water use restrictions. Provincial representatives on the WRT and the OWDC will maintain regular contact.

Emergency Measures Ontario will be included in the discussions at both the local and provincial levels and, depending on the situation, go into action.

Sections 4 and 5 provide more detail on the response process.

3.4 Ontario Water Directors' Committee (OWDC)

The Ontario Water Directors' Committee will be established if any watershed moves into a confirmed Level II condition. For 2000, the OWDC should be composed of the appropriate field directors (depending on the location of the affected watershed) from the Ministries of Natural Resources, Environment and Agriculture, Food and Rural Affairs. Water policy directors from MOE, MNR, OMAFRA and MMAH will also be part of this committee.

This group will be directly linked to the water response team through provincial representatives (see section 4.2).

The primary tasks of the provincial team will be to:

- coordinate provincial response to WRT recommendations
- ensure that the province's responsibilities are fulfilled
- support the WRT in carrying out water use restrictions and allocation decisions.

3.5 Priority Water Uses

When Level III conditions develop, governments have to deal with the question of priority use. Various approaches to this difficult situation have been proposed and used in Ontario and in other jurisdictions. A synthesis of these approaches suggests a basic model that can be applied. This model divides water uses into three classes: essential, important and non-essential.

<u>Essential</u>

Essential uses of water deal with human life and health: a reasonable supply of water for drinking and sanitation, water for health care, water for public institutions and public protection (wastewater treatment, some fire protection, schools), water for critical power generation and water necessary for basic ecological functions.

Important

The second category deals with uses important for the social and economic well being of a particular area. This includes activities critical to industrial processes, commercial facilities such as hotels and restaurants and key agricultural crops. This category poses the most difficulty, as it may be necessary to rank priorities between activities and between groups within the same activity, for example between farm irrigation and a local car manufacturing plant or between tobacco and corn farming. Another complicating factor is that priorities will vary between watersheds.

The local WRT should lead discussions with their local groups well in advance of a drought. These discussions would help establish priorities and set up mitigating strategies. For example, depending on the nature of the business it may be economically viable to truck in water.

Non-Essential

Non-essential uses can be interrupted for the short term without significant impact. These include private swimming pools, lawn watering, public and private fountains and vehicle washing. Many Ontario jurisdictions already have bylaws and other controls to deal with this category.

Restricting water use is only a short term solution. Best planning practices and good long term management of supply and demand must be our first effort. While the above categories do not strongly reflect ecological health considerations, long term economic health is intertwined with ecological health, and if natural water systems are consistently starved of water major catastrophe is not far off.

4. LOCAL WATERSHED RESPONSE

4.1 Generic Response Model

Although supported by provincial legislation, allocation decisions involve bargaining and negotiating with local managers and users. Ultimately, the goal is to balance efficient use, protection of the resource, and equity among users. For these reasons, decisions on low water and drought response and water allocation are best made by a combination of provincial regulators and local water managers and users.

4.2 Water Response Teams

A network of watershed-based water response teams (WRT) is proposed to coordinate local activities. Teams will consist of local water users and local and provincial water managers. Water response teams will use a combination of water data, provincial and local legislation, communication techniques and local tools to advocate for conservation. Success of any WRT depends on local support and commitment to abide by the team's recommendations. In cases of extreme drought, the WRT will ensure that key local and provincial decision-makers participate actively in the process to see that water allocation decisions are understood, supported and enforced.

Water response teams are focused on reacting to current low water conditions. Long term drought prevention efforts must be developed and are the responsibility of existing water management agencies and users. Drought management will only be successful through this combination of long-term preventive strategies and shorter-term crisis management actions.

4.2.1 Institutional Arrangements

Several existing institutions, policies and statutes in Ontario address water management, including drought. Examples are provincial ministries (Environment and Natural Resources), conservation authorities, the *Ontario Water Resources Act* and *Environmental Protection Act*. WRTs will not replace the functions of these organizations, but permit coordination of response among these institutions, non-government groups and users. The WRT does not possess any unique legislative authority but can help coordinate the use of current regulations and tools.

4.2.2. Scale

Water response teams will be based on watershed boundaries. Conservation authority boundaries will determine each team's geographic jurisdiction. Where no conservation authority exists, the Ministry of

Natural Resources will determine the appropriate watershed units. Watersheds may be combined into larger units for drought response.

4.3 Water Response Team Membership and Roles

The WRT will provide a coordinated response from provincial, conservation authority, municipal, private and special interest water managers and users. Teams will work cooperatively, sharing all information and responsibility.

WRTs will include provincial, municipal and conservation authority staff as well as representatives for local interests and users. Team membership will represent the following sectors:

- agriculture
- rural private industry and business
- recreation
- resource management interests
- First Nations
- municipal government
- provincial government

Their organizational mandates, legislative tools, communications abilities and background data require certain organizations to be members of the WRT. These include:

local municipalities

- may monitor and control public water supplies and can provide useful data on watershed characterization
- may control water consumption through bylaws
- can promote strong water conservation messages
- maintain communication links with large local water consumers, specifically commercial and industrial operations
- have specific responsibilities under the *Emergency Plans Act*.

local conservation authorities

- maintain detailed water monitoring networks, which will enhance provincial stations and better describe drought variations
- are watershed based and maintain data that can be used to characterize the watershed's unique features.
- maintain strong links with local community groups, media and government and may facilitate coordination of water conservation messages
- operate dams and reservoirs
- can verify MNR data and low water conditions in the field
- administer sections of the Federal *Fisheries Act* and have some legislative authority for maintaining baseflows to protect aquatic life

- are responsible for some local stream health and water quality monitoring.

Ontario Ministry of Natural Resources

- assists in maintaining a provincial network to monitor low flow conditions. This data can be provided to WRTs. MNR will also analyze data to provide early warnings.
- administers portions of the federal *Fisheries Act* and has some legislative authority for maintaining baseflows to protect aquatic life
- operates dams and reservoirs
- maintains links with local outdoor recreation groups
- maintains a provincial link to ensure long term drought prevention activities are coordinated across ministries and with WRTs.
- administers the *Lakes and Rivers Improvement Act*.

Ontario Ministry of the Environment

- assists in maintaining a provincial water monitoring network
- manages the Permit to Take Water Program (PTTW) under the *Ontario Water Resources Act*. This database of local users can be provided to the WRT to help characterize local water demand conditions. In cases of extreme drought, MOE may control new water takings or limit water takings by existing permit holders.
- maintains communication links with permit holders
- administers the *Ontario Water Resources Act* and the *Environmental Protection Act* and has legislative authority for maintaining baseflows to protect water quality and aquatic life
- maintains a provincial link to ensure long term drought prevention activities are coordinated across ministries and with WRTs.

Ontario Ministry of Agriculture, Food and Rural Affairs

- maintains communication links with agricultural water users and can advise groups of potential local drought conditions and water conservation recommendations
- can coordinate local agricultural representation on the WRT
- maintains a provincial link to ensure long term drought prevention activities are coordinated across ministries and with WRTs.

The participation of other local groups and users is also necessary for success of the WRT. Examples include First Nation communities, dominant local industries (i.e., pulp and paper, aggregates, hydro-electric power generators), recreation users (Trent Severn Waterway, downhill ski facilities) or special interest bodies (such as Niagara Escarpment Commission, Oak Ridges Moraine).

There is no distinction in decision-making power or responsibility among members of the WRT. Each representative should have equal opportunity for input and share in the responsibility. It is therefore imperative that the

membership of the WRT accurately reflect the balance among the sectors within the watershed.

Responsibilities for team members include attending meetings, communicating back to their sector, sharing relevant data, and using drought management tools.

In certain regions, conservation authorities or municipalities may not exist, and the network of local users may vary significantly. For these reasons WRT membership is intended to be flexible.

Confirming membership, electing a chair and appointing a secretary will be done during initial meetings of the WRT. Teams should not be too big to function. Where they exist, local conservation authorities will take the lead in establishing the water response team.

Several watersheds in Ontario already have multi-stakeholder committees that address issues such as local water quality and natural heritage. These committees are encouraged to assume the responsibilities of a WRT if appropriate. They may need to add members.

5. COORDINATION AND ADMINISTRATION

5.1 Response Action Plan

Water Response Team Start Up

The Ministries of Natural Resources and Environment are responsible for monitoring low water conditions. They will notify conservation authorities and MNR district offices of potential low water conditions. Conservation authorities will verify this data with their own monitoring network. Consideration will also be given to local water supply shortages and requests from local groups and organizations. Following this review, conservation authorities, or MNR if there is none for the area, may choose to mobilize a WRT.

Water Response Team Action Plan

1. Conservation authorities (MNR if there is none) will call and host the first WRT meeting to review its goals and objectives. These include:
   - organize WRT
   - identify local water supply needs and concerns
   - identify severity of low water crisis
   - implement water conservation, preservation and allocation strategies
   - evaluate effectiveness of local actions
   - provide advice to local and provincial decision-makers.

2. Conservation authorities (MNR if there is none) confirm or determine if the watershed is in a Level I, II or III condition based on monitoring network data, local water shortages, use allocation difficulties and stakeholder concerns.

3. WRT will finalize its membership. Members will represent agriculture, rural private industry and business, recreation, resource management interests, First Nations, municipal government and provincial government.

4. WRT will elect a chair and secretary from its membership.

5. WRT will develop its terms of reference, detailing mandate, membership, roles (chair, secretary), meeting frequency, quorum conditions and team and external communications needs.

6. WRT will develop a brief summary of existing information about the watershed that generally describes supply and demand conditions. The summary will help

the WRT to target their response and serve as a context for communications. Minimal resources should be used in developing this summary.

The local water supply information should include:

- MNR, MOE and conservation authority precipitation, streamflow and groundwater level data summaries
- general status of municipal wells, rural dug and drilled wells
- anecdotal information on local effects.

The water demand information should include:

- summary listing of water takers based on Permit to Take Water Program and other databases
- general assessment of water taking sectors i.e., agriculture (irrigation areas, livestock demands), recreation (golf courses), industry (aggregates)

6. WRT identifies the actions needed to manage the drought or low water conditions and carries them out. The actions will maximize water supply, reduce demand, or do both.

The recommendations offered here are the minimum. Teams should develop their own solutions to address local problems.

Level I Response: Actions to Consider

Goal: Promote voluntary water conservation among all users to prevent further water shortages

Target: 10% reduction in water use among all sectors

Action	Detail
Communicate	- each WRT member responsible for water conservation communications within their sector - include media releases, farm papers, newsletters, newspapers, radio, etc. - messages focus on - watershed characterization information - statement of local conditions and near term prognosis - strong encouragement for voluntary water conservation with 10% reduction target
Impose restrictions	- none
Prepare for Level II	- develop a database of users based on Permit to Take Water database

Recommendations for water conservation will be sector specific. Many examples are already in place and are to be used by the WRT where available. Residential examples include:

- installing toilet dams
- using rain barrels
- repairing leaky faucets
- encouraging minimal use of non-essential water (car washing, lawn watering)

Other examples are in *Green Tips*, published by the Ontario Ministry of the Environment.

For the agricultural sector, see OMAFRA fact sheets (1999) *How to Prepare for Irrigation During Water Shortages* and *Private Water Well Owners – Dealing with Water Shortages*.

Level II Response: Actions to Consider

Goals: Target water conservation messages more directly
Publicize water use restrictions
Ensure compliance with restrictions
Consider priorities for water allocation at Level III

Target: Further 10% water use reduction (20% total)

Action	Detail
Communicate	- strongly encourage voluntary reductions by contacting key users - key users identified from database developed during Level I Response - contact includes mailings, personal contact, advertising, provincial contact with permit holders and meetings - messages focus on - specific water conservation examples using fact sheets where available - further 10% reduction target
Manage supply	- modify flood prevention, flow augmentation and power generation reservoir operations to minimize effects of drought - increase monitoring of compliance with good water use practices
Impose restrictions	- limit new permit approvals - consider limits for existing permit holders - impose municipal water restrictions through bylaws - monitor water takings for compliance with permits and bylaws
Prepare for Level III (Drought)	- assess impact of water allocation reduction scenarios on each sector (agriculture, recreation, municipal government, provincial government, resource management interests, private industry and business, First Nations) - consider priorities for water allocation - notify local and provincial decision-makers of actions already taken to prepare them for their involvement at Level III

Level III Response (Drought): Actions to Consider

Goal: Develop and implement water allocation protocols
Target: Maximum possible reduction in water consumption in all sectors

Action	Detail
Involve senior decision-makers	- involve senior local and provincial decision-makers directly in developing and implementing water allocation decisions; maintain regular contact with the Ontario Water Directors' Committee
Develop and implement allocation priorities	- use notes from Level II Response in assessing impact of water allocation reduction scenarios on each sector - develop priorities for water allocation among sectors recognizing consensus may be defined as a majority opinion rather than 100% support -impose water allocations using existing tools such as local bylaws and provincial legislation.

Water allocation rather than conservation becomes the focus during the severe shortages experienced in a Level III condition. Actions move from largely voluntary compliance to regulatory control. Because of this shift, senior local and provincial decisions-makers should be included as part of the WRT if they are not already members. Strong local and provincial support will be necessary to make and enforce allocation decisions. Heads of local municipal councils and conservation authorities as well as provincial district managers should now be directly involved in the process. Local team representatives of private groups are also encouraged to involve their senior provincial representatives. Existing legislation such as the *Ontario Water Resources Act* and local municipal bylaws may be used to implement water allocation decisions.

8. Monitoring

During all three levels of response, MNR and MOE as well as conservation authorities and municipalities should continue monitoring activities and communicate results to the WRT regularly. This allows the WRT to anticipate and respond to changes in an effort to avoid further conflict.

9. Communications

The WRT will maintain communication links with the province, conservation authorities, municipalities and private and special interests through its members. These communications are critical to generate awareness and support for local needs and WRT decisions.

10. Evaluation

WRTs will conduct annual self evaluations during the drought and at the conclusion of the drought to assess equity, efficiency and effectiveness of communications, information, actions and monitoring.

5.2 Future Refinements

A comprehensive low water and drought management strategy for Ontario requires a combination of long term preventive strategies and shorter term crisis management actions. These actions should protect existing water supplies, modify the demand for water or do both. Ontario Water *Response - 2000* outlines specific crisis management actions. While longer term preventive strategies are also necessary, the need for a coordinated response by May 2000 has been the priority of this plan.

6. SUMMARY

Level	Indicator	Information flow	Decision	Goal	Target	Communications	Supply management	Imposed restrictions
I – potential water supply problems	Precipitation: <80% long or mid-term average Streamflow: <70% summer average	From: Env. Canada, MNR, CAs, MOE To: MNR for analysis Then: WRT for visual confirmation	By province, in some cases by WRT chair Confirmed by WRT chair	Voluntary conservation	10% reduction in water use	WRT members to own groups Media releases, newsletters, etc. Local conditions		
II – minor problems, potential major supply problems	Precipitation: <60% long, mid-term or short-term average or more than 1 week no rain Streamflow: <30% summer average	as above	By province or WRT chair Confirmed by WRT Set up Provincial Dought Coordinating Committee	Conservation and restrictions	Additional 10% reduction	Direct contact with major users Sector-specific info on restrictions	Modify reservoir operations	Limit new permits Implement bylaws Monitor compliance
III – supply fails to meet usual demand, social and economic impact	Precipitation: <40% long, mid or short-term average Streamflow: <30% summer average	as above	Uusally by WRT chair with chair of provincial committee	Conservation, restrictions and regulation	Maximum reduction	Sector and user specific info on restrictions, regulations	Modify reservoir, water power operations Consider bulk water transfers	Reduce permit levels Set and insititute allocation priorities Enforcement

Appendix 1:Existing Legislation

Summary of Water-related Legislation - Water Quality, Water Quantity, and Water-Related Land Management (1992)

SUMMARY OF MAJOR LEGISLATION ON WATER QUALITY

Legislation by function	Administering agency	Description of legislation	Implementing agency
Provincial Legislation			
***Ontario Water Resources Act**	MOE	• allows for the regulation of water supply • allows surveillance and monitoring of all surface and ground water in Ontario • regulates sewage disposal and controls water pollution • allows MOE to construct and operate waste water facilities or require it be done by an industry or municipality	MOE
***Environmental .Protection Act**	MOE	• forbids discharge of any contaminant to the environment in amounts exceeding regulations • prohibits discharge of any substance likely to impair the environment • requires spills of pollutants be reported and cleaned up promptly and establishes a liability on the party at fault	MOE
Environmental Assessment Act	MOE	• requires assessment of any major public or designated private undertaking that may be altered or cancelled if found to have environmentally unacceptable effects	MOE
Pesticides Act	MOE	• controls se of chemicals for the destruction of plant and animal pest and investigates possible harmful effects of pesticides on the environment	MOE
Conservation Authorities Act	MNR	• establishes conservation authorities with the mandate to operate dams for water quality enhancement, undertake water quality surveys and comment on planning documents	Cas

Legislation by function	Administering agency	Description of legislation	Implementing agency
Lakes and Rivers Improvement Act	MNR	• ensures proposed water works do not adversely affect water quality or cause undue erosion and silting	MNR
Planning Act	MMAH	• guides municipal planning activities (eg. requires local governments to assess the impact of a proposed subdivision on existing water supplies)	Municipalities, MMAH
Municipal Act	MMAH	5. grants municipalities the power to pass bylaws that prohibit the injuring or fouling of drains and sewer connections	Municipalities, MMAH
Federal Legislation			
*Fisheries Act	DFO	• protects fish habitat by prohibiting habitat disturbance and deposition of deleterious substances in water frequented by fish	DFO, MNR
Environmental Contaminants Act	Env. Canada HWC	• prevents dangerous contaminants from entering the environment	Env. Canada HWC
Canada Shipping Act	Transport Canada	• controls pollution from ships by imposing penalties for dumping pollutants or failing to report a spill	Dept. of Transport
Canada Water Act	Env. Canada	• authorizes agreements with provinces for designation of water quality management areas and other projects	Env. Canada
Canadian Environmental Protection Act	Env. Canada	• controls manufacture, transportation, use, disposal of chemicals and wastes not adequately regulated by other legislation	Env. Canada
Pest Control Products Act	Agriculture Canada	• regulates products used to control pests via registration according to prescribed standards	Agriculture Canada

MMAH - Ministry of Municipal Affairs and Housing
MNR - Ministry of Natural Resources
MOE - Ministry of Environment
DFO - Department of Fisheries and Oceans Canada
Env. Canada - Environment Canada
CA - conservation authority
HWC - Health and Welfare Canada
***Includes tools that can be used for drought management response within 24 hours.**

SUMMARY OF MAJOR LEGISLATION ON WATER QUANTITY

Legislation by function	Administering agency	Description of legislation	Implementing agency
Provincial Legislation			
Conservation Authorities Act	MNR	• authorizes conservation authorities to prohibit or regulate fill, construction and watercourse alteration • allows for construction and maintenance of flood and erosion control structures	CAs
Lakes and River Improvement Act	MNR	• empowers MNR to regulate the construction and operation of water works • requires that new water works be approved	MNR
Public Lands Act	MNR	• authorizes MNR to construct and operate dams and acquire land for their purposes • authorizes power generation projects on Crown land	MNR
Municipal Act	MMAH	• allows municipalities to enact bylaws for the construction, repair and maintenance of drains • prohibits the injury or fouling of drains in rivers • empowers municipalities to pass bylaws governing the construction and maintenance of dams and the straightening of water courses for flood protection	municipalities, MMAH
Public Utilities Act	MMAH	• empowers municipalities to acquire and operate water works and divert a lake or river for their purposes	municipalities, MMAH
Ontario Water Resources Act	MOE	• requires a permit for water withdrawals greater than 50,000 litres/day • requires a well construction permit for ground water withdrawals • allows MOE to allocate water among competing users • allows municipalities to establish or replace water works with ministerial approval	MOE
Federal Legislation			
Fisheries Act	DFO	• protects fish habitat by prohibiting	DFO, MNR

Legislation by function	Administering agency	Description of legislation	Implementing agency
		habitat disturbance • ensures construction of a fishway around any obstruction in a waterway	
Navigable Waters Protection Act	Transport Canada	• prohibits dumping of wastes that may interfere with navigation • prohibits construction in navigable waters	Dept. of Transport
Canada Water Act	Env. Canada	• authorizes agreements with provinces for the delineation of flood plains and hazardous shorelines for flood and erosion control	Env. Canada
International Rivers Improvement Act	External Affairs Env. Canada	• prohibits damming or changing the flow of a river flowing out of Canada	Env. Canada

MMAH - Ministry of Municipal Affairs and Housing
MNR - Ministry of Natural Resources
MOE - Ministry of Environment
DFO - Department of Fisheries and Oceans Canada
Env. Canada - Environment Canada
CA - conservation authority
HWC - Health and Welfare Canada

SUMMARY OF WATER-RELATED LAND MANAGEMENT LEGISLATION

Legislation by function	Administering agency	Description of Legislation	Implementing agency
Provincial Legislation			
Drainage Act	OMAFRA	• facilitates construction, operation and maintenance of rural drainage works • provides legal mechanism where riparian landowners can drain their lands and divide the costs among themselves	OMAFRA, municipalities
Tile Drainage Act	OMAFRA	• provides for low interest loans to farmers from municipalities for tile draining their property	municipalities, MMAH
Planning Act	MMAH	• provides for and governs land use planning • deals with provincial administration in land use planning and local planning • provides for development of statements of provincial interest to be regarded in the planning process	municipalities, MMAH
Public Lands Act	MNR	• authorizes MNR to manage and control activities on Crown land	MNR
Mining Act	MNDM	• registers mining lands and lands forfeited to the Crown • exempts lands and mining rights from taxes	MNDM, MNR
Beds of Navigable Waters Protection Act	MNR	• declares the beds of navigable waters as the Crown's responsibility	MNR
Public Transportation and Highway Improvement Act	MTO	• requires a permit for any work carried out within the right-of-way of a provincial highway	MTO
Conservation Authorities Act	MNR	• empowers conservation authorities to manage, regulate or acquire floodplains, hazardous shorelines and conservation lands	
Environmental Assessment Act	MOE	• requires environmental assessments for designated land use activities	MOE
Federal Legislation			
Fisheries Act	DFO	• controls erosion and sedimentation for the purpose of fish habitat preservation	DFO, MNR

MNR - Ministry of Natural Resources
MOE - Ministry of Environment
DFO - Department of Fisheries and Oceans Canada
MTO - Ministry of Transportation
MNDM - Ministry of Northern Development and Mines
OMAFRA - Ministry of Agriculture, Food and Rural Affairs

Appendix 2: Additional Technical Information

Distinguishing Between the Levels of Response

Thresholds for Level I must be senstive enough to give enough time for action but not so sensitive as to activate when problems are not likely to occur. Some areas may reach the threshold for Level I several years in a row. Indicators will be monitored and reviewed periodically to determine if the thresholds are set at the correct levels.

Indicators

Research was done in 1999 to find out how precipitation and streamflow data might be used to quantify low water and drought conditions. Based on this experience, the project team has used precipitation and streamflow as the two primary indicators.

Precipitation Indicator 1

For each station, MNR will compare the monthly precipitation with the average expected monthly precipitation for that station, for that month. For each month, the comparison will use the total precipitation in the month divided by the average expected precipitation for that month. These calculations will then be averaged over the previous 18 months (long term) and the previous three months (seasonal).

When an area reaches a Level I or higher condition, the comparison for the previous month for each station will also be used. As well, a weekly comparison will be made on the 7th, 14th, and 21st of each month comparing the accumulated 1, 2 and 3-week precipitation to the average precipitation for the current month.

Precipitation Indicator 2

In a Level I condition or greater, the number of consecutive readings of less than 7.6mm (no rain) will be determined at each reading (on the 7th, 14th, 21st and at the end of the month).

In sensitive watersheds (very high water demand or very sandy soils), all readings of less than 7.6mm will be noted. In a less sensitive watershed, (moderate water demand and sandy soils or high demand and silty soils), two or more consecutive readings of less than 7.6mm will be noted. These one or two readings of less than 7.6mm will be used as thresholds.

Streamflow

Surface flow indicators demonstrate if there is enough streamflow in the river to meet the basic needs of the ecosystem and if there is additional water available for needs such as navigation, recreation, hydropower generation, irrigation, and other takings.

Baseflow response contributes to surface flow and indicates the state of the groundwater supply. After a rainfall or snowmelt, there may be an immediate surface runoff response in streamflow followed, sometimes after a delay, by a baseflow response from groundwater. In many cases, baseflow is relied upon to provide the needs of the ecosystem and to maintain the surface water quality at an acceptable level. Baseflow response will indicate if there is enough water to meet basic needs. If baseflow is insufficient, water management authorities will have to manage the structures to provide water for surface water takings.

In the spring, a surplus of supply means surface flows will be much higher than at other times of the year. It is necessary to take this into account when determining streamflow indicators. As a result, thresholds were selected to reflect seasonal variability. It is also necessary to recognize that wide, flat streams and headwater streams (streams at the top of the watershed) are more sensitive to low flows. Representative streamgauge stations need to be selected to take account of varying stream channel conditions.

Streamflow Indicator

Water level gauges that relate water level to water flow (streamflow) provide data used for surface flow, or streamflow, indicators. An indication of streamflow approaching the minimum needed to maintain the ecosystem is the statistical flow value, 7Q20. (The minimum 7-day, 1-in-20-year flow that is calculated for individual gauges.)

The historical average monthly flow, for each month for each station is available from the Environment Canada streamflow historical archive HYDAT. For each station, the lowest average summer month flow will be the lowest average monthly flow for July, August or September. Comparing the value of the current flow with the historic low value will determine when the streamflow is approaching the 7Q20. All flow indicators will be expressed as a per cent of the lowest average summer month flow. On the 14th of each month, when a Level I or greater condition has been attained, there will also be a calculation of the flow for the first half of the month that will be compared to the lowest average flow.

For the analysis at the provincial level, the criteria will be the same for all streamflow gauges. In April, May, and June flows are expected to be higher, therefore, the indicator flows will be expected to be higher. This will be factored into the streamflow thresholds. While a low flow in the springtime may not indicate existing water supply problems, it indicates potential problems in the summer.

Local Streamflow Indicator

Streams in the head waters or those having high width-to-depth ratio are expected to be more sensitive to low flows. An indication of streamflow approaching the minimum needed to maintain the ecosystem in these streams is the statistical flow value, 7Q2. (The minimum 7-day 1-in-2-year flow, which is also calculated for individual gauges.). At the local level, where this detail is known, the indicator flows can be higher than for the main channel streams or streams that are narrow and deep. The local WRT can factor this into the streamflow thresholds.

Aquifer Level Indicator

In the future, water table elevations will be used as groundwater indicators. In vulnerable areas, there is a need to identify consumption, including a need to estimate well pumping rates. From well logs and specific capacity data, MOE can estimate the required water table elevations, assuming well screens and pumps are in the best locations to optimize the aquifer's use. This exercise leads to a"first cut" threshold for water table elevations for the users. The thresholds would be refined through tests on specific wells before drought conditions or through data collected during a drought.

Precipitation Thresholds

Level I Condition

A watershed enters Level I when its 3-month or 18-month precipitation drops below 80% of the average 3-month or 18-month precipitation for those months.

Level II Condition

The threshold for Level II condition is 60% of the 1-month, 3-month or 18-month average expected precipitation. A watershed enters Level II when its 3-month or 18-month total precipitation drops below 60% of the average 3-month or 18-month precipitation for those months or its 1-month total precipitation drops below 60% of the average precipitation and it is already in a Level I condition.

The weekly update to the monthly per cent of average (calculated on the 7th, 14th, and 21st) indicates improving or degrading conditions but is not used to

determine a Level II condition. This measurement is only taken during an existing Level I or Level II condition.

OR

The threshold for Level II condition may also be more 2 or more consecutive readings of less than 7.6mm precipitation (no rain). A watershed enters Level II when there is an existing Level I condition and, in high-demand areas, a reading of cumulative precipitation less than 7.6mm and, in moderate-demand areas, 2 or 3 readings in succession when the cumulative precipitation is less than 7.6mm. At the local level, when precipitation is monitored daily, a watershed enters Level II if it has 7 to 14 days of less than 7.6mm in a sensitive area and, in a less sensitive area, 14 to 21 days of less than 7.6 mm.

The watershed reenters Level I when both indicators have risen above the Level II thresholds.

Level III Condition

The threshold for the Level III condition is 40% of the 1-month, 3-month or 18-month average expected precipitation. A watershed enters Level III when the 3-month or 18 month total precipitation drops below 40% of the average 3-month or 18-month precipitation for those months or its 1-month total precipitation drops below 40% of the average precipitation and there is an existing Level II condition.

The weekly update to the monthly per cent of average (calculated on the 7th, 14th, and 21st) indicates improving or degrading conditions but is not used to determine a Level III condition. This measurement is only taken during an existing Level I or Level II condition.

The watershed reenters Level II when both indicators have risen above the Level III thresholds.

Streamflow

For Level II and Level III conditions, streamgauges known to represent more sensitive streams (streams in headwaters or wide and shallow streams) may have the comparison levels raised by 10%. For example, more sensitive streams may enter Level II in the spring when the flow drops below 80% of the lowest average summer month flow. The WRT should address this level of detail at the local level.

Groundwater Baseflow Protection

Baseflow indicators have not been identified for implementation by April 2000. In the future, baseflow will be measured and comparisons made with observed conditions. At present, it is believed that a Level I threshold would occur when baseflow approaches demands + minimum for natural function. Level II and

Level III thresholds would be set a number of days ahead of the dates the thresholds are reached to deal with wells that cause induced recharge. There is a need to identify wells that significantly influence baseflow.

Groundwater Aquifer levels

Aquifer level indicators have not been identified for implementation by April 2000. Well logs and capacity data can be used to estimate representative groundwater elevations. A network for measuring the water table should be developed. Measurements taken in 2000 will be used to determine when water tables drop near to or below demand levels. Threshold water table levels will be developed. Water table levels near demand level would generate a Level I condition. Exceeding the demand level would generate a Level II condition. A Level III condition would occur when water levels drop below the level needed for high-priority demand. Critical water table heights for baseflow protection need to be determined.

Monitoring and Reporting

Data Acquisition

Precipitation and streamflow data is obtained through the MNR Water Resources Information System (WRIS) computer located in Toronto and maintained through the MNR Sault Ste. Marie office. Climate data is obtained from Environment Canada through satellite connection and decoded by WRIS. This data is obtained through a cost sharing agreement between Environment Canada and MNR (including the conservation authorities) and MOE.

To get the data in real time for the purpose of flood management, the streamgauges are equipped with telemetry devices that are funded outside the cost share agreement by the conservation authorities and MNR. Streamflow data and precipitation data located at streamflow sites is collected by telephone modem and decoded by WRIS.

Spreadsheets identify Environment Canada Synoptic stations and functioning streamflow gauging sites. Precipitation and streamflow data is obtained manually from WRIS and entered into the spreadsheets, which are sent by e-mail to MNR Peterborough.

In Peterborough the historic streamflow and climate records are used to determine monthly average historical values for each station. These values are compared to the current data sent to Peterborough and the indices are calculated and linked to a Geographic Information System (GIS) database. Indices are plotted on base maps showing the watershed boundaries. These maps are analyzed, the data checked when unexpected numbers occur and new maps generated. From these maps a Conditions Report is prepared.

Conservation authorities will be contacted and advised of the data requirements and will be asked to confirm their willingness to participate and ensure the availability of streamflow and precipitation data. When the data cannot be obtained through the WRIS computer, a system will be established for the conservation authority to provide the data to MNR Peterborough by e-mail.

Addressing Gaps

The major improvements for 2000 over 1999 are to increase the geographic coverage of the data, especially precipitation, choose a variety of stream types, and obtain data manually from streamflow gauging sites that transmit unreliably. MOE will collect groundwater and provide it to MNR Peterborough for calculation of indicators and presentation in GIS format. Accurate base mapping is needed to evaluate water supply by watershed.

MNR will work with conservation authorities, Environment Canada and OMAFRA to fill in the gaps in the precipitation network and to refine the streamgauge network. An additional 25 precipitation stations with real-time data will be added. Data for reliable precipitation stations, available on the OMAFRA web site, will be polled. Arrangements will be made with conservation authorities to refine the streamgauge network, to obtain additional precipitation data and to obtain by e-mail data unavailable through WRIS. Arrangements will be made with conservation authorities to ensure that streamgauge stations are maintained and provide consistently reliable data.

Baseflow was analyzed against precipitation because current groundwater data were not available. These analyses were conducted at selected stations in representative sensitive areas as an indicator of groundwater impact. This approach served as an indicator of groundwater conditions.

One of the most significant annual inputs in the water cycle is snowmelt. We need a means of determining how much water is available for melting from the snow pack and whether it is replenishing the supply or evaporating. In 2000, SSM/I (Special Sensor Microwave Imager) data from satellite imagery will be used to determine the snow water content of the snowpack (25km resolution) across Ontario. Starting with the snow survey reading for February 1, 2000, every Monday, Wednesday and Friday until the snow is gone or until May 30, 2000, the amount of water equivalent in the snowpack and the depth of snow on the ground will be measured and the snow pack density determined. The data is compared to and corrected using the snow survey data available from MNR in Sault Ste. Marie.

Assessment Process and Communicating

Summary precipitation data and data from streamgauges will be obtained manually from WRIS. Additional precipitation and streamgauge information unavailable through WRIS will be obtained by e-mail. Other data from 25 additional climate stations from Environment Canada and other sources of precipitation data will be obtained manually, by e-mail or from Internet sites.

All this data will be entered onto spreadsheets that will go to MNR Peterborough where they will be linked to spreadsheets containing precipitation monthly averages and the lowest average summer flows. The per cent of average will be determined electronically and presented on base mapping showing the watershed boundaries. Contour maps will be generated and plotted and used to determine the indicators and thresholds.

Adobe versions of these maps will be posted to an Intranet web site and distributed electronically to Conservation Ontario along with the conditions report and analysis. MOE has still to determine the data collection methods and how communication of the data to MNR for evaluation and inclusion in maps will be achieved. Baseflow and groundwater elevation data will be obtained and provided to MNR Peterborough in spreadsheet or database format.

Appendix 3: Project Team

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